Selected Abstracts from Physical Review D

Abstracts of papers published in **Physical Review D** *which may be of interest to our readers are printed here.*

Nonequilibrium QCD: Interplay of hard and soft dynamics in high-energy multigluon beams. Klaus Geiger, *Brookhaven National Laboratory, Department of Physics 510-A, Upton, New York 11973.* (Received 25 November 1996)

A quantum-kinetic formulation of the dynamical evolution of a high-energy nonequilibrium gluon system at finite density is developed to study the interplay between quantum fluctuations of high-momentum (hard) gluons and the low-momentum (soft) mean color field that is induced by the collective motion of the hard particles. From the exact field equations of motion of QCD, a self-consistent set of approximate quantum-kinetic equations are derived by separating hard and soft dynamics and choosing a convenient axial-type gauge. This set of master equations describes the momentum space evolution of the individual hard quanta, the space-time development of the ensemble of hard gluons, and the generation of the soft mean field by the current of the hard particles. The quantum-kinetic equations are approximately solved to order $g^2(1+g\overline{A})$ for a specific example, namely, the scenario of a high-energy gluon beam along the light cone, demonstrating the practical applicability of the approach. [S0556-2821(97)00817-5] [Phys. Rev. D **56**, 2665 (1997)]

Mean field approach to the instanton-induced effects close to the QCD phase transition. M. Velkovsky and E. Shuryak, *Department of Physics, State University of New York, Stony Brook, New York 11794.* (Received 23 April 1997)

It was suggested earlier that the chiral phase transition is driven by a transition from random instanton–anti-instanton liquid to correlated instanton–anti-instanton molecules. So far this phenomenon was studied by numerical simulations, while we develop an alternative semianalytic approach. For two massless quark flavors, both instantons and ''molecules'' generate specific four-fermion effective interactions. After those are derived, we determine the temperature dependence of the thermodynamic quantities, the quark condensate, and the fraction of molecules using the standard mean field method. Using the Bethe-Salpeter equation, we calculate the T-dependence of mesonic correlation functions. These results shed new light on the problem of modification of hadrons, and they can be tested directly in lattice simulations. [S0556-2821(97)04515-3] [Phys. Rev. D **56**, 2766 (1997)]

Influence of multiple scattering on vector boson production in a medium. A. V. Koshelkin, *Moscow Engineering Physics Institute, Kashirskoye sh.31, Moscow 115409, Russia.* (Received 31 October 1996)

Vector boson production by spinless particles undergoing multiple elastic collisions with isotropically scattering centers in a medium is investigated. The cross section of the boson production is calculated. It is shown that the boson production process is suppressed for massive bosons. In the case of an extremely small boson mass, the obtained cross section tends to the photon production cross section. [S0556-2821(97)00117-3] [Phys. Rev. D **56**, 2778 (1997)]

Factorization for hard exclusive electroproduction of mesons in QCD. John C. Collins, *Department of Physics, Penn State University, 104 Davey Lab., University Park, Pennsylvania 16802;* Leonid Frankfurt, *Physics Department, Tel-Aviv University, Tel Aviv, Israel;* Mark Strikman, *Department of Physics, Penn State University, 104 Davey Lab., University Park, Pennsylvania 16802.* (Received 26 November 1996)

We formulate and prove a QCD factorization theorem for hard exclusive electroproduction of mesons in QCD. The proof is valid for the leading power in Q and all logarithms. This generalizes previous work on vector meson production in the diffractive region of small x. The amplitude is expressed in terms of off-diagonal generalizations of the usual parton densities. The full theorem applies to all kinds of mesons and not just to vector mesons. The parton densities used include not only the ordinary parton density, but also the helicity density (g_1 or Δq) and the transversity density (h_1 or δq), and these can be probed by measuring the polarization of the produced mesons with unpolarized protons. [S0556-2821(97)01317-9] [Phys. Rev. D **56**, 2982 (1997)]

$\overline{\nu_\mu} \leftrightarrow \overline{\nu_e}$ mixing: Analysis of recent indications and implications for neutrino oscillation phenomenology. G. L. Fogli, E. Lisi, and G. Scioscia, *Dipartimento di Fisica and Sezione INFN di Bari, Via Amendola 173, I-70126 Bari, Italy.* (Received 12 February 1997)

We reanalyze the recent data from the Liquid Scintillator Neutrino Detector (LSND) experiment that might indicate $\overline{\nu_\mu} \leftrightarrow \overline{\nu_e}$ mixing. This indication is not completely excluded by the negative results of established accelerator and reactor neutrino oscillation searches. We quantify the region of compatibility by means of a thorough statistical analysis of all the available data, assuming both two-flavor and three-flavor neutrino oscillations. The implications for various theoretical scenarios and for future oscillation searches are studied. The relaxation of the LSND constraints under different assumptions in our statistical analysis is also investigated. [S0556-2821(97)02715-X] [Phys. Rev. D **56**, 3081 (1997)]

***CP* violation and matter effect in long baseline neutrino oscillation experiments.** Jiro Arafune, Masafumi Koike, and Joe Sato, *Institute for Cosmic Ray Research, University of Tokyo, Midori-cho, Tanashi, Tokyo 188, Japan.* (Received 14 March 1997)

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We show simple methods of how to separate pure CP-violating effects from matter effects in long baseline neutrino oscillation experiments with three generations of neutrinos. We give compact formulas for neutrino oscillation probabilities assuming one of the three neutrino masses (presumably ν_τ mass) to be much larger than the other masses and the effective mass due to the matter effect. Two methods are shown. One is to observe envelopes of the curves of oscillation probabilities as functions of neutrino energy; a merit of this method is that only a single detector is enough to determine the presence of CP violation. The other is to compare experiments with at least two different baseline lengths; this has the merit that it needs only a narrow energy range of oscillation data. [S0556-2821(97)02617-9] [Phys. Rev. D **56**, 3093 (1997)]

Inelasticity in p-nucleus collisions and its application to high energy cosmic-ray cascades. G. M. Frichter, T. K. Gaisser, and T. Stanev, *Bartol Research Institute, University of Delaware, Newark, Delaware 19716.* (Received 2 April 1997)

We employ a simple multiple scattering model to investigate the inclusive reaction $p+A\rightarrow p+X$ for projectile momenta in the 100–200 GeV/c range. We find that data are consistent with a class of interaction models in which the stopping power of nuclei is rather low. We discuss extrapolation to ultrahigh energy and the application to interpretation of cosmic-ray air showers at energies up to 10^{20} eV. [S0556-2821(97)06017-7] [Phys. Rev. D **56**, 3135 (1997)]